MODULATION TECHNIQUES FOR HIGH SPEED WIRELESS LOCAL AREA NETWORK SYSTEM

IVAN INDHAM AK ROLAND

Universiti Malaysia Sarawak
2000

Borang Penyerahan Tesis
Universiti Malaysia Sarawak

R13a

BORANG PENYERAHAN TESIS

Judul: **HIGH SPEED MODULATION TECHNIQUES FOR WIRELESS LOCAL AREA NETWORK SYSTEM**

SESI PENGAJIAN: 1997/2000

Saya, **IVAN INDHAM AK ROLAND ASAN**

mengaku membenarkan tesis ini disimpan di Pusat Khidmat Maklumat, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Hakmilik kertas projek adalah di bawah nama penulis melainkan penulisan sebagai projek bersama dan di biayai oleh UNIMAS, hakmiliknya adalah kepunyaan UNIMAS.
2. Naskah salinan di dalam bentuk kertas atau mikro hanya boleh dibuat dengan kebenaran bertulis daripada penulis.
3. Pusat Khidmat Maklumat Akademik, UNIMAS dibenarkan membuat salinan untuk pengajian mereka.
4. Kertas projek hanya boleh diterbitkan dengan kebenaran penulis. Bayaran royalti adalah mengikut kadar yang dipersetujui kelak.
5. * Saya membenarkan/tidak membenarkan Perpustakaan membuat salinan kertas projek ini sebagai bahan pertukaran di antara institusi pengajian tinggi.
6. ** Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan).
☑	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS)

Alamat Tetap: 3/383,
Jalan Bunga Raya,
95400 Saratok,
Sri Aman,
Sarawak

Tarikh: 30·3·00

(TANDATANGAN PENYELIA)

Mr. Ng Liang Yew
Nama Penyelia

Tarikh: 8/4/00

CATATAN * Potong yang tidak berkenaan
** Jika Kertas Projek ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyertakan sekali tempoh kertas projek. Ini perlu dikelaskan sebagai SULIT atau TERHAD.

Tesis ini telah dibaca dan disahkan oleh:

Liang Yew

Mr. Ng Liang Yew

8/4/00

Tarikh

MODULATION TECHNIQUES FOR HIGH SPEED WIRELESS LOCAL AREA NETWORK SYSTEM

IVAN INDHAM AK ROLAND ASAN

Tesis Dikemukakan Kepada
Fakulti Kejuruteraan, Universiti Malaysia Sarawak
Sebagai Memenuhi Sebahagian daripada Syarat
Penganugerahan Sarjana Muda Kejuruteraan
Dengan Kepujian (Kejuruteraan Elektronik dan Telekomunikasi)
2000

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREAVIATIONS

AC	– Alternate Current
LAN	– Local Area Network
WAN	– Wide Area Network
MAN	– Metropolitan Area Network
WLAN	– Wireless Local Area Network
BPSK	– Binary Phase Shift Keying
QPSK	– Quadrature Phase Shift Keying
CCK	– Complementary Code Keying
CCSK	– Cylic-code Shift Keying
PPM	– Pulse-position Modulation
QAM	– Quadrature Amplitude Modulation
OCDM	– Orthogonal Code Division Multiplexing
OFDM	– Orthogonal Frequency Division Multiplexing
MBOK	– M-ary Biorthogonal Keying
RF	– Radio Frequency
FHSS	– Frequency Hopping Spread Spectrum
DSSS	– Direct Sequence Spread Spectrum
IR	– Infrared
NOS	– Network Operating System
PC	– Personal Computer
EP	– Extension point
AP	– Access Point
FCC	– Federal Communications Commission
ISM	– Instrumentation, Scientific, and Medical

IEEE – Institute for Electrical and Electronic Engineers

MSDUs – MAC (Medium Access Control) Service Data Units

LLC – Logical Link Control

FFT – Fast Fourier Transform

PN – Pseudonoise

MUX – Multiplexer

MSI – Modulation Symbol Index

GPL – General-Purpose Language

FIFO – First In First Out

ACOLADE – Advanced Communication Link Analysis Design

DSP – Digital Signal Processing

Mbps – Mega (10^6) bits per second (Mega = 10^6)

Msps – Mega symbols per second

Mcps – Mega chips per second

MHz – Mega Hertz

GHz – Giga (10^9) Hertz

To my parent, brothers and my sisters.

ACKNOWLEDGEMENT

It is a pleasure to acknowledge my debt to the many people involved, directly or indirectly in the establishment of this thesis. First of all, I would like to thanks Almighty God for giving me strength and such an opportunity to complete this thesis.

To my supervisor, Mr. Ng Liang Yew, a full and deepest appreciation for his guide, advice and criticism throughout developing thee project and writing this thesis, that I could never get from anyone else.

To my parent, especially my mom, Alice Gelang, you have been the greatest things happen to my life. To my dad, Roland Asan, without you, there is nothing else that I can rely on. To my brother, Jesse Tayai and my sister, Tracy Biby, both of you have been a true family and friend indeed.

I also would to thanks my colleagues for their support in all kind and you all have been a really good company.

ABSTRACT

Wireless Local Area Network is a new emerging technology in the wireless communication era. Parallel to the widespread of Information Technology (IT), this technology is started to adopt by the network users. The term wireless here indicates that the users become more portable and the need for complex networking cabling installation is not a major problem anymore.

The system performance of this wireless communication is increases as the design of new transmission system is introduced. The wireless data transmission rate is one of the main components that each vendor of this wireless technology wishes to upgrade to their maximum level. The purpose of project is to analyze one of the selected modulation techniques applied in Wireless LAN in how the system could increase the data transmission rate up to 11 Mbps and introduce a simulation approach to represent the behavior of the system.

ABSTRAK

Telekomunikasi menggunakan medium udara atau tanpa wayar yang diaplikasikan dalam rangkaian komputer kawasan tempatan adalah satu teknologi baru yang semakin berkembang dalam era komunikasi. Selari dengan perkembangan teknologi maklumat, teknologi ini semakin diterime oleh pegguna-pengguna rangkaian komputer. Telekomunikasi tanpa wayar ini membolehkan pegguna-pengguna lebih bebas bergerak dan masalah pemasangan wayar yang kompleks untuk rangkaian komputer dapat diatasi. Pretasi sistem ini juga semakin hari semakin meningkat dengan terciptanya sistem penghantaran data yang baru. Para pengeluar komponen untuk system ini berusaha untuk meningkatkan kadar penghantaran data ke tahap maksimum. Projek ini bertujuan untuk membuat analisa terhadap salah satu sistem penghantaran data atau modulasi yang diaplikasikan dalam teknologi ini tentang bagaimana ia boleh menigkatkan kadar penghantaran data hingga mencapai 11 Mega bit per saat.

Chapter 1

Introduction

Basically, there is three main type of networking nowadays: LAN (Local Area Network), WAN (Wide Area Network) and MAN (Metropolitan Area Network). The concept of networking is to sharing information and interacts to one and another. The method of connection for each computer to terminal devices is also varied or in networking term; the topology is different, depend who set up the networking. Just couple of year's back, the Wireless Local Area Network (WLAN) become available, and this mean, the user is portable with their portable accessing devices.

1.1 Problem Statement

The WLAN as it is still new but come as one of solutions for the problem mentioned. However, the data transmission rates are another factor for WLAN to perform in their optimum performance and also for the user convenience. Speed can reduce time, and time is money. For this reason, a more complex modulation techniques should be introduced to replaced current WLAN system that employ binary phase-shift keying (BPSK) and quadrature phase-shift keying (QPSK) that only performs in 1 and 2 Mbps (Mega bits per second) system.

1.2 Objective

The objective of this project is to show a simulation approach of one of the selected current Direct Sequence Spread Spectrum (DSSS) modulation technique namely M-ary Biorthogonal Keying (MBOK). The analysis of the simulation result should be able to show an increasing of data transmission rate up 11 Mbps.

1.3 Project overview

Chapter 1 will cover the introduction of overall project. Chapter 2 includes the literature review that cointain the material and sources that I have gathered in research stages. Chapter 3 will cover the simulation stage development and Chapter 5 described the implementation process. Finally, Chapter 6 covers the problems encountered during the completion of the project, recommendations and my conclusion about the project

Chapter 2

Wireless Local Area Network

2.0 Definition

A wireless local area network (LAN) is a flexible data communications system implemented as an extension to, or as an alternative for, a wired LAN. The term wireless networking refers to technology that enables two or more computers to communicate using standard network protocols, but without network cabling. Strictly speaking, any technology that does this could be called wireless networking. The current buzzword however generally refers to wireless LANs. Using radio frequency (RF) technology, wireless LANs transmit and receive data over the air, minimizing the need for wired connections. Thus, wireless LANs combine data connectivity with user mobility.

Wireless LANs have gained strong popularity in a number of vertical markets, including the health-care, retail, manufacturing, warehousing, and academia. These industries have profited from the productivity gains of using hand-held terminals and notebook computers to transmit real-time information to centralized hosts for processing. Today wireless LANs are becoming more widely recognized as a general-purpose connectivity alternative for a broad range of business customers. Business Research Group, a market research firm, predicts a six-fold expansion of the worldwide wireless LAN market by the year 2000, reaching more than $2 billion in revenues.

2.1 Wireless LAN Technology

Manufacturers of wireless LANs have a range of technologies to choose from when designing a wireless LAN solution. Each technology comes with its own set of advantages and limitations.

2.1.1 Narrowband Technology

A narrowband radio system transmits and receives user information on a specific radio frequency. Narrowband radio keeps the radio signal frequency as narrow as possible just to pass the information. Undesirable cross talk between communications channels is avoided by carefully coordinating different users on different channel frequencies.

A private telephone line is much like a radio frequency. When each home in a neighborhood has its own private telephone line, people in one home cannot listen to calls made to other homes. In a radio system, privacy and noninterference are accomplished by the use of separate radio frequencies. The radio receiver filters out all radio signals except the ones on its designated frequency.

From a customer standpoint, one drawback of narrowband technology is that the end-user must obtain an FCC (Federal Communications Commission) license for each site where it is employed.

2.1.2 Spread Spectrum Technology

Most wireless LAN systems use spread-spectrum technology; a wideband radio frequency technique developed by the military for use in reliable, secure, mission-critical communications systems. Spread-spectrum is designed to trade off bandwidth efficiency for reliability, integrity, and security. In other words, more bandwidth is consumed than in the case of narrowband transmission, but the tradeoff produces a signal that is, in effect, louder and thus easier to detect, provided that the receiver knows the parameters of the spread-spectrum signal being broadcast. If a receiver is not tuned to the right frequency, a spread-spectrum signal looks like background noise. There are two types of spread spectrum radio: frequency hopping and direct sequence.

2.1.2.1 Frequency-Hopping Spread Spectrum (FHSS) Technology

Frequency-hopping spread-spectrum (FHSS) uses a narrowband carrier that changes frequency in a pattern known to both transmitter and receiver. Properly synchronized, the net effect is to maintain a single logical channel. To an unintended receiver, FHSS appears to be short-duration impulse noise.

2.1.2.2 Direct-Sequence Spread Spectrum (DSSS) Technology

Direct-sequence spread-spectrum (DSSS) generates a redundant bit pattern for each bit to be transmitted. This bit pattern is called a chip (or chipping code). The longer the chip, the greater the probability that the original data can be recovered (and, of course, the more bandwidth required). Even if one or more bits in the chip are damaged during transmission, statistical techniques embedded in the radio can recover the original data without the need for retransmission. To an unintended receiver, DSSS appears as low-power wideband noise and is rejected (ignored) by most narrowband receivers.

2.1.3 Infrared Technology

This technology, little used in commercial wireless LANs, is infrared. Infrared (IR) systems use very high frequencies, just below visible light in the electromagnetic spectrum, to carry data. Like light, IR cannot penetrate opaque objects; it is either directed (line-of-sight) or diffuse technology. Inexpensive directed systems provide very limited range (3 ft) and typically are used for personal area networks but occasionally are used in specific wireless LAN applications. High performance directed IR is impractical for mobile users and is therefore used only to implement fixed sub-networks. Diffuse (or reflective) IR wireless LAN systems do not require line-of-sight, but cells are limited to individual rooms.

2.2 Operation of Wireless LANs

Wireless LANs use electromagnetic airwaves (radio or infrared) to communicate information from one point to another without relying on any physical connection. Radio waves are often referred to as radio carriers because they simply perform the function of delivering energy to a remote receiver. The data being transmitted is superimposed on the radio carrier so that it can be accurately extracted at the receiving end. This is generally referred to as modulation of the carrier by the information being transmitted. Once data is superimposed (modulated) onto the radio carrier, the radio signal occupies more than a single frequency, since the frequency or bit rate of the modulating information adds to the carrier.

Multiple radio carriers can exist in the same space at the same time without interfering with each other if the radio waves are transmitted on different radio frequencies. To extract data, a radio receiver tunes in one radio frequency while rejecting all other frequencies.

In a typical wireless LAN configuration, a transmitter/receiver (transceiver) device, called an access point, connects to the wired network from a fixed location using standard cabling. At a minimum, the access point receives, buffers, and transmits data between the wireless LAN and the wired network infrastructure. A single access point can support a small group of users and can function within a range of less than one hundred to several hundred feet. The access point (or the antenna attached to the access point) is usually mounted

high but may be mounted essentially anywhere that is practical as long as the desired radio coverage is obtained.

End users access the wireless LAN through wireless-LAN adapters, which are implemented as PC cards or wireless networking interface card in notebook or palmtop computers, as cards in desktop computers, or integrated within hand-held computers. Wireless LAN adapters provide an interface between the client network operating system (NOS) and the airwaves via an antenna. The nature of the wireless connection is transparent to the NOS.

2.3 Wireless LAN Configurations

Wireless LANs can be simple or complex. At its most basic, two PCs equipped with wireless adapter cards can set up an independent network whenever they are within range of one another. This is called a peer-to-peer network (see Figure 2.1). On-demand networks such as in this example require no administration or preconfiguration. In this case each client would only have access to the resources of the other client and not to a central server.